Physics 8-04 Resistors Lab **_Name:_** ______________

Objective:

- Discover properties of resistors in series, parallel, and both series and parallel.

Materials:

- Snap circuits kit (3 resistors (1 kΩ, 5.1 kΩ, 10 kΩ), 1 switch, 1 battery holder, 2 3-snap connectors, 2 4-snap connectors) (or can be done with breadboards and resistors)
- Digital multimeter with probes
- 2 AA batteries

Procedure:

Part 1: Measuring Resistance

The largest resistor in your set is 10 kΩ, so set the dial on the multimeter to 20kΩ. This is the largest resistance the meter will measure in this setting. Remember that it is kΩ, so a reading of 5.1 is 5.1 kΩ or 5100Ω.

- Plug the black probe into the COM port of the multimeter.
- Plug the red probe into the VΩmA port of the multimeter.
- Turn on the multimeter.
- Place one probe on the snap of each side of a resistor.
- Record the actual resistance of the resistor.
- Repeat for the other two resistors.

1 K = ________________

5.1 K = ________________

10 K = ________________

Part 2: Series Circuits

A series circuit is one where there is only one path for the current to follow. All the resistors are arranged in a line.

- Snap the resistors together in a straight line.
- Measure the total resistance (a probe on each end of the line).

R_S = __________________

1. How does this value compare to the individual resistances? ______________________________________
2. The total resistance in series should equal the sum of the resistances. How close are you? Calculate the % error.
   $\%\ error = \frac{measured - theoretical}{theoretical} \times 100\%$ ____

Part 3: Parallel Circuits

A parallel circuit is one where there are multiple paths for the current to follow. The resistors can be arranged to make parallel lines.

- Snap the resistors onto the 4-snap connectors so that the resistors are parallel with one end on each 4-snap connector.
- Measure the total resistance (a probe on the empty snap of each 4-snap connector).

R_P = __________________

3. How does this value compare to the individual resistances? ___________________
4. The total resistance in parallel can be found with $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$. How close are you? Calculate the % error.
   $\%\ error = \frac{measured - theoretical}{theoretical} \times 100\%$ ____

Part 4: Partially in Series and Parallel

Build the circuit in the picture. Part of the circuit is in parallel, and part is in series.

- Calculate the parallel portion first.
- Combine that value with the resistor in series to the parallel portion.

$R_{Theoretical}$ = ______________________

- Measure the resistance from one end to the other.

$R_{Measured}$ = ______________________

5. Calculate the percent error between the theoretical and measured. ___________________________________

Part 5: Measure Voltage

Voltage is the electrical potential that causes electrons to move through the circuit. It is very similar to potential energy. This can be measured with your multimeter. To measure voltage, one probe needs to be on each side of the component that you are measuring the potential over. (The meter is connected in parallel.)

- Place 2 AA batteries in the battery holder.
- Each battery should have a maximum voltage of 1.5 V and there are two in series, so turn the dial of the multimeter to read a maximum of 20 V.
- Touch the snaps on the battery holder to measure the voltage of the batteries.

V = ___________________

Part 6: Measure Current

Build the circuit in the picture.

To measure current, the current must go through the meter. So, you need to break the circuit and connect a probe to each part of the break.

- Remove the switch to break the circuit and measure the current by placing one probe on the snap of each side of the break. This allows the current to flow through the meter.
- Adjust the dial of the meter until you get a value to 3 significant figures of the current.

$I_{Measured}$ = ___________________

- The current can be calculated with V = IR. Using your measured values of V and R, calculate the I.

$I_{Theoretical}$ = _________________

6. Calculate the % error for the current.

   ____

Extension:

7. Combine the resistors partially in series and parallel to get different equivalent values than what you have already calculated in this lab. Find at least 4 alternatives. Draw them here along with their equivalent resistances. While you are doing this, do #8 below for each alternative.

$R_{calculated}$ = ___________________ $R_{measured}$ = ___________________	$R_{calculated}$ = ___________________ $R_{measured}$ = ___________________
$R_{calculated}$ = ___________________ $R_{measured}$ = ___________________	$R_{calculated}$ = ___________________ $R_{measured}$ = ___________________